KEY CONCEPTS IN SCIENCE
Unit number: ASC1

Section B – ASC1/C (Chemistry)
Tuesday 23 January 2018 Morning

Time allowed: 1 hour 30 minutes

For this paper you must have:
• a calculator
• Periodic Table
• separate insert for Question 02.1
• formulae sheet.

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

[Turn over]
INSTRUCTIONS

- Use black ink or black ball-point pen.

- Answer ALL questions in each section.

- You must answer the questions in the spaces provided. Do not write on blank pages.

- Do all rough work in this book. Cross through any work you do not want to be marked.

- The total time for all three sections of this paper is one-and-a-half hours.
INFORMATION

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60 and the maximum mark for this section is 20.
- You will be provided with a copy of the Periodic Table and formulae sheet.
- There are three sections in this paper:
  Section A – Biology
  Section B – Chemistry
  Section C – Physics.

ADVICE

- You are advised to spend approximately 30 minutes on this section.
- Please read each question carefully before starting.

DO NOT TURN OVER UNTIL TOLD TO DO SO
SECTION B – CHEMISTRY

Answer ALL questions in this section.

01. Analytical chemists use indicators and pH curves to determine the end point of a titration. FIGURE 1, on page 5, shows titration curves for combinations of different acids and bases.

All solutions have the same concentration.

01.1 Select from A, B, C and D the curve produced by the addition of: [3 marks]

- ethanoic acid (a weak acid) to 25 cm$^3$ of sodium hydroxide
- ammonia solution (a weak base) to 25 cm$^3$ of hydrochloric acid
- hydrochloric acid to 25 cm$^3$ of sodium hydroxide
FIGURE 1

[Graphs showing pH changes with volume for A, B, C, and D.]
TABLE 1 shows some acid–base indicators and the pH ranges over which they change colour.

**TABLE 1**

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>pH RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bromophenol blue</td>
<td>3.0–4.6</td>
</tr>
<tr>
<td>Phenol red</td>
<td>6.8–8.2</td>
</tr>
<tr>
<td>Bromothymol blue</td>
<td>6.0–7.6</td>
</tr>
<tr>
<td>Thymolphthalein</td>
<td>9.3–10.5</td>
</tr>
</tbody>
</table>

State which indicator from TABLE 1 could be used in the titration that produces curve D but not in the titration that produces curve C.

Explain your choice. [2 marks]

Indicator ____________________________

Explanation _________________________

_____________________________________

_____________________________________

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_____________________________________
An analytical chemist at a vinegar manufacturer used titration to monitor the concentration of ethanoic acid in vinegar.

The chemist:

- diluted 50.0 cm³ of the vinegar with distilled water to make a total volume of 500 cm³
- titrated a 25.0 cm³ sample against a standard solution of 0.100 mol dm⁻³ NaOH.

\[
\text{NaOH} + \text{CH}_3\text{COOH} \rightarrow \text{CH}_3\text{COONa} + \text{H}_2\text{O}
\]

sodium hydroxide + ethanoic acid → sodium ethanoate + water
The results are shown in TABLE 2.

TABLE 2

<table>
<thead>
<tr>
<th>Volume / cm³</th>
<th>Rough</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>At start</td>
<td>0.00</td>
<td>20.20</td>
<td>0.00</td>
<td>14.45</td>
</tr>
<tr>
<td>At end</td>
<td>20.20</td>
<td>39.40</td>
<td>14.45</td>
<td>33.55</td>
</tr>
<tr>
<td>Used</td>
<td>20.20</td>
<td>19.20</td>
<td>14.45</td>
<td>19.10</td>
</tr>
</tbody>
</table>

Calculate the average volume of sodium hydroxide used in the experiment. [1 mark]

Average volume = _________________ cm³
01.4 Calculate the number of moles of sodium hydroxide used in the experiment.

Use your answer from Question 01.3.
[1 mark]

Number of moles used = ________________

01.5 State the number of moles of ethanoic acid that reacted with the number of moles of sodium hydroxide in Question 01.4.
[1 mark]

_____________________________________

_____________________________________

01.6 Calculate the concentration of the ORIGINAL sample of ethanoic acid. [2 marks]

Concentration = ________________ mol dm$^{-3}$
Research chemists use trends in the properties of some elements to predict the properties of other elements.

TABLE 3 shows the values of atomic radii for the elements in Group 0 that the research chemist found.

<table>
<thead>
<tr>
<th>Element</th>
<th>Atomic Number</th>
<th>Atomic Radius /m × 10⁻¹²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Helium</td>
<td>2</td>
<td>28</td>
</tr>
<tr>
<td>Neon</td>
<td>10</td>
<td>58</td>
</tr>
<tr>
<td>Argon</td>
<td>18</td>
<td>106</td>
</tr>
<tr>
<td>Krypton</td>
<td>36</td>
<td>116</td>
</tr>
<tr>
<td>Xenon</td>
<td>54</td>
<td>140</td>
</tr>
<tr>
<td>Radon</td>
<td>86</td>
<td>150</td>
</tr>
</tbody>
</table>

Plot a graph of atomic radius against atomic number on FIGURE 2 on the separate insert for Question 02.1.

Draw a line of best fit. [2 marks]
02.2 Identify the anomalous result. [1 mark]

_____________________________________
_____________________________________
_____________________________________

02.3 Explain why atomic radius increases as atomic number increases in Group 0. [2 marks]

_____________________________________
_____________________________________
_____________________________________
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_____________________________________
_____________________________________
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[Turn over]
A large proportion of the elements of the Periodic Table are metals.

Aluminium is a metal widely used in the aerospace industry.

Give the electron configuration of an atom of aluminium, Al. [1 mark]

_____________________________________
_____________________________________
_____________________________________

Describe the bonding in aluminium. Include a labelled diagram in your answer. [4 marks]
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